

dichloroethane, then 51.0 mL of thionyl chloride. The mixture is heated to reflux for 4 hrs. The reaction is quenched by adding 20 mL of methanol. Removal of solvent gives a white crystalline mass of tris(2-chloroethylamine) hydrochloride in quantitative yield.

To the flask is added 500 mL of deionized water, 100 g of sodium sulfite. An oil phase is separated first. After heating at 60° C. for 2 hrs and 98° C. for 5 hrs, the oil phase disappears and a clear solution is obtained. HPLC and LC-MS shows complete conversion of the starting material to the desired sodium tritaurinate.

The crude reaction solution is transferred to a 2 L autoclave, to which 26 g of sodium hydroxide and 600 mL of 25% aqueous ammonia are added. The autoclave is heated to 220° C. for 2 hrs to carry out the ammonolysis reaction.

HPLC and LC-MS analysis shows that sodium tritaurinate is converted to a mixture of sodium taurinate (72%), sodium ditaurinate (23%), and sodium tritaurinate (5%) on the molar basis.

### Example 3

This example demonstrates the conversion of sodium ditaurinate and sodium tritaurinate in the recrystallization mother liquor to sodium taurinate.

To 200 mL of the mother liquor from 2<sup>nd</sup> cooling crystallization stage, composed of sodium ditaurinate (25% by wt), sodium tritaurinate (3% by wt), taurine (5% by wt), and sodium sulfate (6% by wt), is added 15 g of sodium hydroxide, 500 mL of 25% aqueous ammonia. The solution is heated in a 2 L autoclave at 220° C. for 2 hrs to carry out the ammonolysis reaction.

HPLC and LC-MS analysis shows that the reaction solution is comprised of the following taurinates: sodium taurinate (76%), sodium ditaurinate (21%), and sodium tritaurinate (3%) on the molar basis.

### Example 4

This example is directed to a process for the separation of sodium sulfate from sodium taurinate, sodium ditaurinate, and sodium tritaurinate.

A starting solution is prepared by first boiling the solution from the ammonolysis reaction to remove excess ammonia, and then adding enough sulfuric acid to pH 5-7. The solution is consisted of 30% taurine, 26% sodium sulfate, and 7% sodium di- and tri-taurinates.

2000 g of the starting solution is cooled from 80° C. to 33° C. to form a slurry consisting essentially of the first crop of crystallized taurine, which is separated by filtration at 33° C. and washed with 100 g of cold water. The recovered taurine is dried and weighed 398 g.

The separated mother liquor, weighed 1580 g, is boiled to evaporate to 900 g to form a slurry of sodium sulfate. This slurry is cooled to 80° C. and filtered to recover sodium sulfate, weighed 304 g.

The mother liquor, containing 202 g of taurine and 216 g of sodium sulfate, is cooled to 33° C. to form second slurry of taurine. After filtration and washing with cold water, 124 g of taurine is obtained.

The mother liquor from the previous step, now containing 78 of taurine and 216 g of sodium sulfate, is added a solution

of sodium hydroxide to pH 11, saturated with ammonia, and cooled to 10° C. in 2 hours to obtain a slurry of sodium sulfate, which is removed by filtration.

This final mother liquor, about 500 g, is consisted of sodium ditaurinate and tritaurinate (28%, 140 g), sodium taurinate (78 g, 15%), and sodium sulfate (35 g, 7%). This solution is used for the ammonolysis reaction.

It will be understood that the foregoing examples, explanation, drawings are for illustrative purposes only and that in view of the instant disclosure various modifications of the present invention will be self-evident to those skilled in the art and are to be included within the spirit and purview of this application and the scope of the appended claims.

What is claimed is:

1. A cyclic process for the production of taurine from alkali isethionate, comprising,

(a) adding an excess of ammonia to a solution of alkali isethionate and subjecting the solution to ammonolysis reaction in the presence of one or more catalysts to yield a mixture of alkali taurinate, alkali ditaurinate, alkali tritaurinate, and unreacted alkali isethionate;

(b) recovering the excess ammonia from (a) and neutralizing the solution with sulfuric acid to obtain a crystalline suspension of taurine in a solution of alkali sulfate, alkali ditaurinate, alkali tritaurinate, and alkali isethionate;

(c) separating taurine from (b) to provide a mother liquor

(d) adjusting the pH of the mother liquor to basic to convert taurine present in the mother liquor to alkali taurinate and prevent the crystallization of taurine, and removing alkali sulfate from the mother liquor by performing evaporative crystallization and cooling crystallization through solid-liquid separation;

(e) returning the mother liquor of (d) to (a) for further ammonolysis of alkali ditaurinate, alkali tritaurinate, and unreacted alkali isethionate.

2. The process according to claim 1, wherein the mother liquor containing alkali ditaurinate, and alkali tritaurinate is mixed with a new batch of alkali isethionate to inhibit the formation of alkali ditaurinate and alkali tritaurinate and to convert alkali ditaurinate and alkali tritaurinate to alkali taurinate during the ammonolysis.

3. The process according to claim 2, wherein alkali ditaurinate and alkali tritaurinate in the returning mother liquor are converted to di-alkali ditaurinate and tri-alkali tritaurinate by adding alkali hydroxide during the ammonolysis.

4. The process according to claim 1, wherein the one or more catalysts for the ammonolysis are comprised of sodium hydroxide, potassium hydroxide, lithium hydroxide, sodium carbonate, potassium carbonate, lithium carbonate, sodium sulfate, sodium sulfite, potassium sulfate, or potassium sulfite.

5. The process according to claim 1, wherein the overall yield is greater than 85%.

6. The process according to claim 1, wherein the overall yield is greater than 90%.

7. The process according to claim 1, wherein the overall yield is greater than 95%, to nearly quantitative.

8. The process according to claim 1, wherein alkali metals are lithium, sodium, and potassium.

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